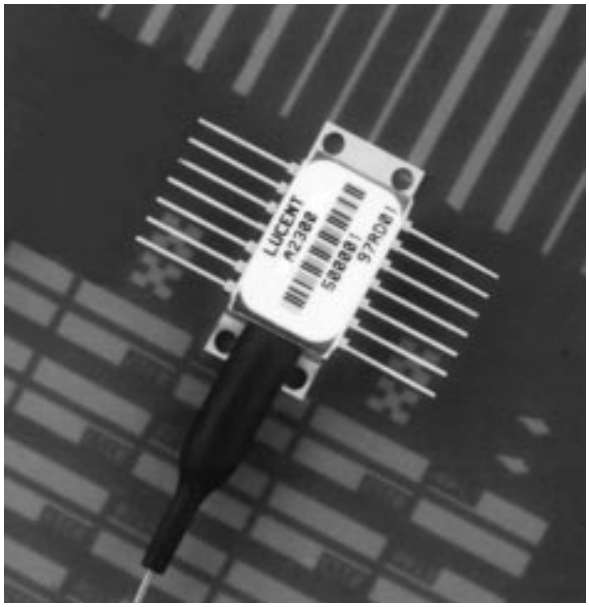
Data Sheet
March 1999

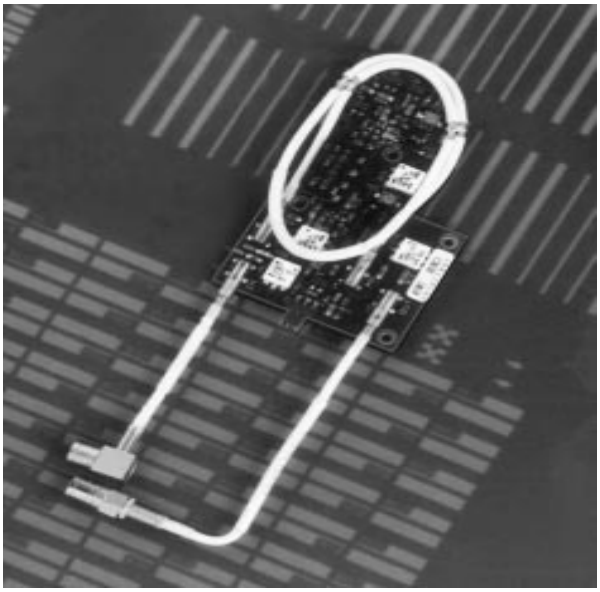
microelectronics group

Lucent Technologies
Bell Labs Innovations

A2300-Type Laser 2000
Analog DFB Laser Module



The A2300-Type, Isolated, Cooled, Analog DFB Laser Module provides enhanced performance in analog transmission systems, with a variety of product options.



A separate predistortion board provides both CSO and CTB correction enhancements to the A2300-Type Laser Module performance, for 110 NTSC as well as 42 CENELEC channels.

Features

- High-performance, multiquantum-well (MQW), distributed-feedback (DFB), semiconductor laser.
- 14-pin, hermetic, butterfly-type package provides internal isolation and thermoelectric cooling/heating functions.
- Stable, accurate, PIN photodetector for laser back-facet optical output power monitoring/control.
- Operation at the low dispersion, 1310 nm wavelength.
- Stable performance over the wide temperature range of –20 °C to +65 °C.
- Multiple product options available:
  — Stand-alone or predistorted.
  — 77/110 NTSC or 42 CENELEC test channel loading.
  — Simulated system testing available in a variety of fiber link budget losses.
  — 25 Ω resistive-matched or 75 Ω transformer-matched input impedances.
- Superior signal quality and system performance compared to present coaxial-based analog systems.

Applications

- Video surveillance
- CATV
- Wireless/personal communications networks and systems

Description

The Laser 2000, A2300-Type Analog DFB Laser Module contains a high-performance, Indium Gallium Arsenide Phosphide, multiquantum-well, distributed-feedback laser chip designed for 1310 nm, single-mode fiber-optic applications. The module is an industry-standard, 14-pin butterfly-type, hermetic, metal/ceramic package and houses the laser chip as well as an integral thermoelectric cooling/heating device, a thermistor, an integral optical isolator, and a laser back-facet optical monitor. The module is equipped with a 900 µm *Hytrel** jacketed, 8.8 µm core, single-mode fiber; several standard fiber-optic connector options are also available.

The integral thermoelectric cooler (TEC) provides stable thermal characteristics for the laser chip, as well as the optical isolator and back-facet monitor photodiode. The TEC allows for heating and cooling of these internal optical components and can maintain their temperature at a constant 25 °C over the entire ambient operating temperature range of –20 °C to +65 °C. The thermistor monitors the internal module temperature and provides feedback control for the TEC. This gives the A2300-Type Laser 2000 superior, stable optical characteristics.

When used in a fiber-optic system, reflected light entering the laser module is attenuated a minimum of 40 dB by the optical isolator. The internal PIN photodiode monitors the optical power emitted from the rear facet of the laser diode, and when used in conjunction with exterior module circuitry, it can monitor and control the optical output power launched into the fiber.

Lucent Technologies offers two different pinout types and RF drive impedance. The first is the Optoelectronics unit standard analog isolated laser module (ILM) pinout, formerly the *ASTROTEC* ® 257-type, and has an input impedance of 75 Ω. The 75 Ω input impedance eliminates the need for external matching circuits and is achieved using an RF transformer internal to the package. This allows the RF drive level into the laser to be typically 4 dB less than if resistive matching were used. The second pinout type, formerly the *ASTROTEC* 247-type, has a resistive input impedance of 25 Ω and matches the pinout of the optoelectronic industry's standard 2.5 Gbits/s package. This module offers the advantage of being a replacement for current competitive analog laser modules.

Lucent Technologies analog laser modules feature the ability to have enhanced performance and value through the addition of the Optoelectronics unit's exclusive predistortion board. The separate predistortion board provides both CSO and CTB correction enhancements to the laser module performance, for 110 NTSC as well as 42 CENELEC channels. While maintaining extremely low electrical power dissipation and low insertion loss, the predistortion board allows 1000 MHz of RF bandwidth.

Every A2300-type Laser 2000 module is tested to meet the customer's analog performance specifications, over the specified fiber link budget loss and test channel plan. This measurement method ensures proper system performance of the product. Lucent Technologies Optoelectronics unit components and products are qualified to the rigorous requirements of Bellcore Standards, ensuring that the optoelectronic performance will meet the needs of the application over the lifetime of the product.

* *Hytrel* is a registered trademark of E.I. DuPont de Nemours and Company.

Pin Information

Type 2

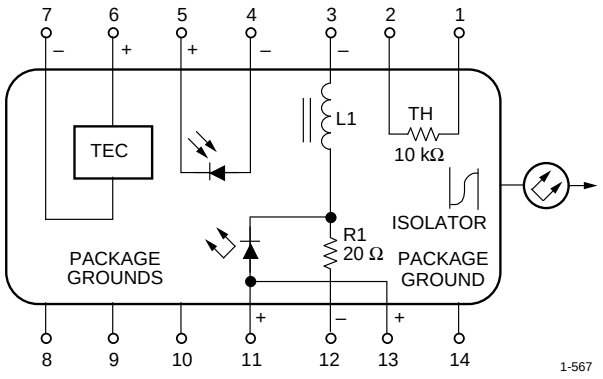


Figure 1. Circuit Schematic (Top View) Industry-Standard (2.5 Gbits/s) Pinout, 25 Ω Resistive Input Impedance

Table 1. Type 2 Pin Descriptions

Pin	Connection
1	Thermistor.
2	Thermistor.
3	Laser (dc Bias) Cathode (–).
4	Back-facet Monitor Anode (–).
5	Back-facet Monitor Cathode (+).
6	Thermoelectric Cooler (+).*
7	Thermoelectric Cooler (–).*
8	Case Ground.†
9	Case Ground.†
10	Case Ground.†
11	Laser Anode (+).‡
12	RF Input; 25 Ω (–).§
13	Laser Anode (+).‡
14	Case Ground.†

* A positive current through the thermoelectric cooler cools the laser.
† Pins 8—10 and 14 must be grounded to RF ground.
‡ Both leads should be grounded for optimum performance.
§ For proper operation, pin 12 (RF input) must be dc decoupled.

- Benefits:
  — Pinout allows drop-in replacement for industry-competitive modules.

Type 3

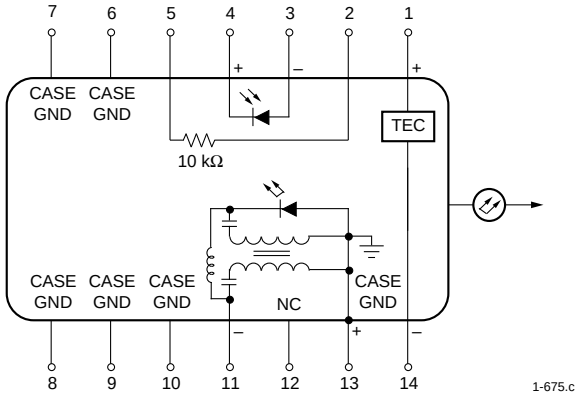


Figure 2. Circuit Schematic (Top View) Lucent Technologies Standard Pinout, 75 Ω Transformer-Matched Input Impedance

Table 2. Type 3 Pin Descriptions

Pin	Connection
1	Thermoelectric Cooler (+).*
2	Thermistor.
3	Back-facet Monitor Anode (–).
4	Back-facet Monitor Cathode (+).
5	Thermistor.
6	Case Ground.†
7	Case Ground.†
8	Case Ground.†
9	Case Ground.†
10	Case Ground.†
11	Laser (dc Bias) Cathode (–) and RF Input; 75 Ω Input.
12	No Connect.
13	Laser Anode (+), Case Ground.†
14	Thermoelectric Cooler (–).*

* A positive current through the thermoelectric cooler cools the laser.
† Pins 6—10 and 13 must be grounded to RF ground.

- Benefits:
  — Transformer allows for 4.0 dB reduction in required RF drive per channel.
  — No impedance matching circuitry required between output of hybrid amplifier and Lucent laser.

Predistortion Function Information

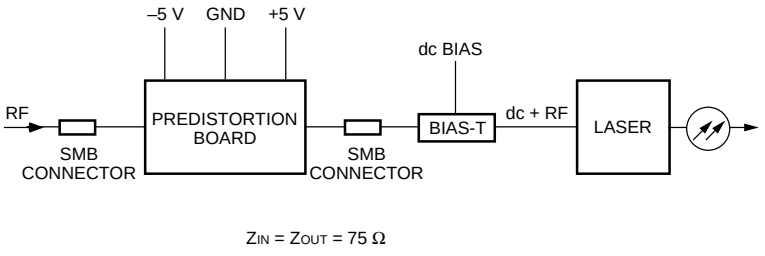
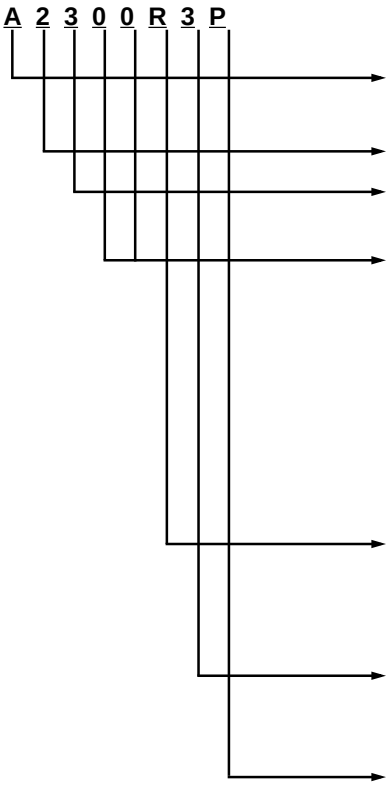


Figure 3. Laser and Predistortion PCB Solution Block Diagram

- Benefits:
  - — Preselected laser matched to separate predistortion board optimizes customer system-level performance.
  - — Lucent Technologies provides predistortion circuitry, no customer design required.
  - — Compatible with Type 3.
  - — CSO and CTB distortion enhancements.

Part Numbering for the Laser 2000 A2300-Type



Field Description

Alpha character indicating product type
A = Analog

2 = Laser 2000

Wavelength indicator
3 = 1.3 μm typical devices

Link loss series and power range
00 → 5 dB link loss (00 through 09)
10 → 7 dB link loss (10 through 19)
20 → 9 dB link loss (20 through 29)
30 → 9 dB link loss; high power (30 through 39)
40 → 11 dB link loss (40 through 49)
50 → 11 dB link loss; high power (50 through 59)
60 → 13 dB link loss (60 through 69)
70 → 13 dB link loss; high power (70 through 79)

Alpha character indicating standard connector options
B = SC-APC; 2.15 m ± 0.2 m
R = FC-APC; 2.15 m ± 0.2 m
D = SC-PC; 2.15 m ± 0.2 m

Package type
2 → Type 2: Industry pinout (25 Ω)
3 → Type 3: Lucent Technologies pinout (75 Ω)

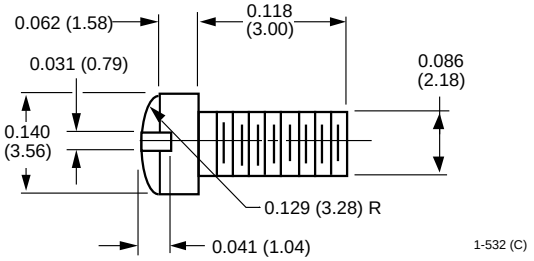
Product configuration
S = Stand-alone laser
P = Predistortion board

Handling Precautions

Mounting Instructions for Laser Module

The minimum fiber bend radius is 1.25 in. To avoid degradation in performance, mount the module on the board as follows:

1. Place the bottom flange of the module on a flat heat sink at least 0.5 in. x 1.180 in. (12.7 mm x 30 mm) in size. The surface finish of the heat sink should be better than 32 µin. (0.8 µm), and the surface flatness must be better than 0.001 in. (25.4 µm). The use of thermal conductive grease is optional; however, thermal performance can be improved by up to 5% if conductive grease is applied between the bottom flange and the heat sink.
2. Mount four #2-56 screws with Fillister heads (M2-3 mm) (see Figure 4) at the four screw-hole locations (see Outline Diagram). The Fillister head diameter must not exceed 0.140 in. (3.55 mm). Do not apply more than 1 in.-lb. of torque to the screws.



Note: Dimensions are in inches and (millimeters).

Figure 4. Fillister Head Screw

Power Sequencing

Adopt the following sequence for turn-on as a matter of good practice to avoid the possibility of damage to the laser module from power supply switching transients.

1. All ground connections.
2. Most negative supply.
3. Most positive supply.
4. All remaining connections.

Reverse the above order for the proper turn-off sequence.

Electrostatic Discharge

CAUTION: This device is susceptible to damage as a result of electrostatic discharge. Take proper precautions during both handling and testing. Follow guidelines such as JEDEC Publication No. 108-A (Dec. 1988).

Lucent employs a human-body model (HBM) for ESD-susceptibility testing and protection-design evaluation. ESD voltage thresholds are dependent on the critical parameters used to define the model. A standard HBM (resistance = 1.5 kΩ, capacitance = 100 pF) is widely used and, therefore, can be used for comparison purposes. The HBM ESD threshold presented here was obtained using these circuit parameters:

Parameter	Value	Unit
Human-body Model	400	V

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Laser Reverse Voltage	—	—	2	V
Laser dc Forward Current	—	—	150	mA
Predistortion Board dc Supply Voltage: Positive Negative	 — —	 — —	 +7 –7	 V V
RF Modulation per Channel (75 Ω)	—	—	0	dBm
Operating Temperature Range	T_A	–20	65	°C
Storage Case Temperature Range	T_{stg}	–40	85*	°C

* 2000 hours maximum.

Characteristics

Minimum and maximum values are testing requirements. Typical values are for informational purposes only and are not part of the testing requirements. Each device is provided with recommended operating conditions to achieve specified performance. T_L = 25 °C, unless noted otherwise. Predistortion board supply voltage is ±5 V, ±10%.

Table 3. Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Laser Forward Voltage	V_{LF}	At rated power	—	1.3	1.8	V
Operating Current	I_{OP}	—	—	50	100	mA
Threshold Current	I_{TC}	*	—	10	40	mA
Monitor Reverse-bias Voltage	V_{MON}	—	3	—	10	V
Monitor Current	I_{MON}	At I_{OP}	0.2	—	2.0	mA
Monitor Dark Current	I_D	I_F = 0, V_{MON} = 5 V	—	—	0.10	µA
Thermistor Current	I_{TH}	—	10	—	100	µA
Thermistor Resistance	R_{TH}	T_L = 25 °C, $I_{TH} \leq$ 0.1 mA	9.5	—	10.5	kΩ
Thermistor Thermal Characteristic	$\Delta R_{TH}/\Delta T_L$	–20 °C ≤ T_L ≤ 65 °C†	—	–4.4	—	%/°C
Thermistor Temperature Coefficient	B	—	3700	3900	4100	K
TEC Current	I_{TEC}	ΔT = 40 °C	—	—	1.0	A
TEC Voltage	V_{TEC}	ΔT = 40 °C	—	—	1.8	V
TEC Cooling Capacity	ΔT	—	40	—	—	°C

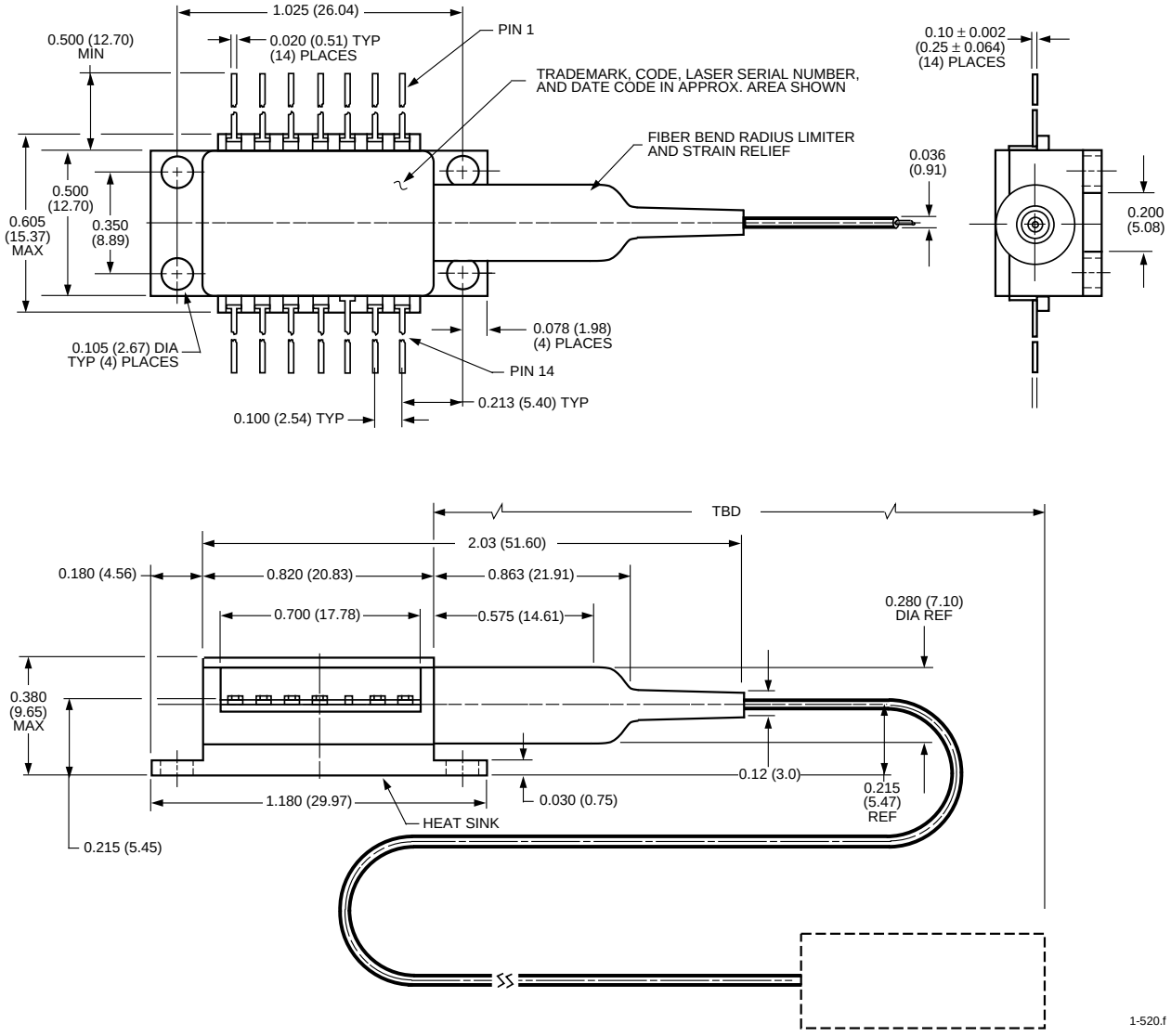
* The laser threshold current is the current at which the first derivative of the laser light vs. forward current is at one-half of its maximum.
† The thermistor thermal characteristic will be monotonic.

Table 4. Optical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Optical Output Power	P_O	—	3.0	—	20.0	mW
Center Wavelength	λ_C	—	1290	1310	1330	nm
Optical Isolation	—	–20 °C to +65 °C	40	45	—	dB
Side-mode Suppression Ratio	SMSR	Modulated	30	—	—	dB

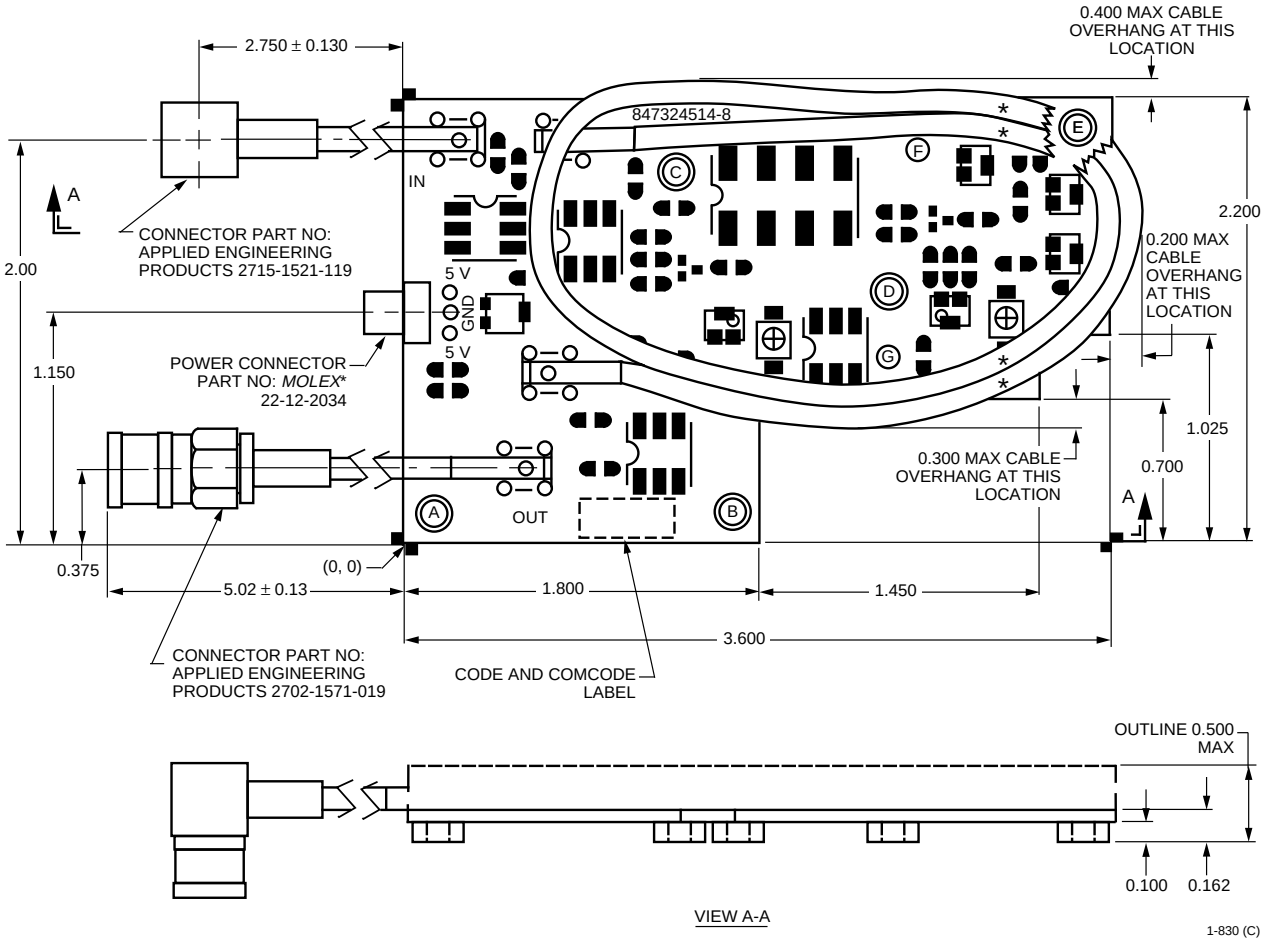
Outline Diagram

Dimensions are in inches and (millimeters).



Predistortion Board

Dimensions are in inches. Tolerances are ±0.005 in. unless noted otherwise.



* *Molex* is a registered trademark of Molex, Inc.

Notes:
Mating connectors from Applied Engineering Products:
PWB mounted straight—2709-1511-001
PWB mounted right angle—2710-1511-000
Cable connector—2701-1571-019

Centerline hole position from (0,0). All holes are unplated.

Designation	Inner Diameter	X	Y
A	0.116	0.150	0.150
B	0.116	1.650	0.150
C	0.116	1.380	1.850
D	0.116	2.450	1.250
E	0.116	3.450	2.050
F	—	2.600	1.955
G	—	2.450	0.925

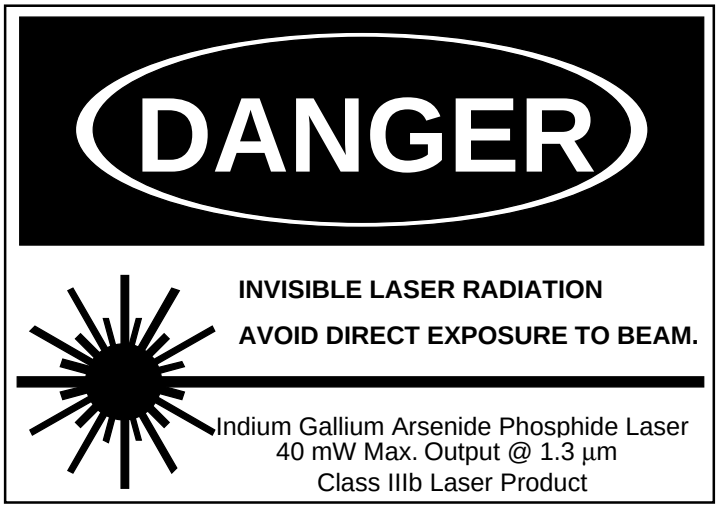
A spacer is inserted in holes A, B, C, D, and E. The diameter listed is the inner diameter of the spacer.

Laser Safety Information

Class IIIb Laser Product

This product complies with 21 CFR 1040.10 and 1040.11.
Single-mode connector
Wavelength = 1.3 µm
Maximum power = 40 mW
Because of size constraints, laser safety labeling is not affixed to the module but is contained on the shipping carton.
Product is not shipped with power supply.

CAUTION: Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.



DANGER
INVISIBLE RADIATION IS EMITTED FROM THE END OF THE FIBER OR CONNECTOR. AVOID DIRECT EXPOSURE TO THE BEAM. DO NOT VIEW WITH OPTICAL INSTRUMENTS.

Ordering Information

Table 5. Analog Product Availability

Tested Loss*	Optical Power (mW)	Channel Capacity	CNR (dBc)	CSO (dBc)	CTB (dBc)	RF Drive (dBm/ Channel)	Package Configuration†	L2000 Part Number†	Comcode
Stand-Alone Short-Haul Lasers									
7 dB: (7f)	2.5—6.5	77 NTSC	43	–61	–67	< –21	75 Ω/Stand-alone	A2303D75	108116740
	2.5—6.5	77 NTSC	43	–61	–67	< –21	75 Ω/Stand-alone	A2303R3S	108406695
	<6.0	77 NTSC	51	–62	–67	< –12	75 Ω/Stand-alone	A2312D3S	108263849
	<6.0	77 NTSC	51	–62	–67	< –12	75 Ω/Stand-alone	A2312R3S	108235706
	4.0—6.5	77 NTSC	51	–63	–67	< –12	75 Ω/Stand-alone	A2307D75	108116732
	4.0—6.5	77 NTSC	51	–63	–67	< –12	75 Ω/Stand-alone	A2307R3S	108406703
	3.0—6.0	42 CEN-ELEC	50	–62	–67	< –6.5	25 Ω/Stand-alone	A2311D2S	108332040
Stand-Alone Long-Haul Lasers									
11 dB: (9f + 2p)	>4	77 NTSC	48	–61	–67	< –9.3	75 Ω/Stand-alone	A2315D75	108116716
	>9	77 NTSC	48	–61	–67	< –9.3	75 Ω/Stand-alone	A2316R3S	108028010
	>9	77 NTSC	50	–62	–67	< –9.3	75 Ω/Stand-alone	A2332D3S	108309618
	>9	77 NTSC	50	–62	–67	< –9.3	75 Ω/Stand-alone	A2332R3S	108406711
	6—10	42 CEN-ELEC	50	–62	–67	< –6.5	25 Ω/Stand-alone	A2350D2S	108332057
	>10	42 CEN-ELEC	50	–62	–67	< –6.5	25 Ω/Stand-alone	A2351B2S	108161365
	>10	42 CEN-ELEC	51	–63	–67	< –6.5	25 Ω/Stand-alone	A2341B2S	108148776
Predistorted Short-Haul Lasers									
11 dB: (9f + 2p)	6—8	42 CEN-ELEC	49	–63	–67	< –6.5	75 Ω/Discrete Pre-D	A2313B3P	108075326
	8—10	42 CEN-ELEC	50	–63	–67	< –6.5	75 Ω/Discrete Pre-D	A2336B3P	108161373

* 7 dB, all fiber; 9 dB includes 2 dB passive loss; 11 dB includes 2 dB passive loss; 13 dB includes 4 dB passive loss.
† Type 2: industry-standard pinout (2.5 Gbits/s type) and a 25 Ω input impedance (resistive). Type 3: Lucent pinout and a 75 Ω input impedance (transformer matched).

Note: Some codes do not conform to the standard ADN configuration scheme. An ADN that ends with D75 denotes a stand-alone module, Type-3 pinout.

Ordering Information (continued)

Table 5. Analog Product Availability (continued)

Tested Loss*	Optical Power (mW)	Channel Capacity	CNR (dBc)	CSO (dBc)	CTB (dBc)	RF Drive (dBm/ Channel)	Package Configuration†	L2000 Part Number†	Comcode
Predistorted Long-Haul Lasers									
11 dB: (9f + 2p)	>10	77 NTSC	52	–61	–67	< –9.3	75 Ω/Discrete Pre-D	A2352R3P	108066739
	>6	77 NTSC	52	–62	–67	< –9.3	75 Ω/Discrete Pre-D	A2334D7P	108116724
	>6	77 NTSC	52	–62	–67	< –9.3	75 Ω/Discrete Pre-D	A2334R3P	108216417
	>8	77 NTSC	51	–62	–67	< –9.3	75 Ω/Discrete Pre-D	A2335D7P	108116682
	6—10	42 CEN-ELEC	52	–63	–67	< –8.0	75 Ω/Discrete Pre-D	A2343B3P	108168220
	10—12	42 CEN-ELEC	52	–63	–67	< –8.0	75 Ω/Discrete Pre-D	A2354B3P	108132390
	13—15	42 CEN-ELEC	52	–63	–67	< –6.0	75 Ω/Discrete Pre-D	A2357B3P	108230541
13 dB: (9f + 4p)	>13	77 NTSC	50	–62	–67	< –9.3	75 Ω/Discrete Pre-D	A2361D3P	108387879
	>13	77 NTSC	50	–62	–67	< –9.3	75 Ω/Discrete Pre-D	A2361R3P	108406729
	>16	77 NTSC	50	–62	–67	< –9.3	75 Ω/Discrete Pre-D	A2362D3P	108357658
	>16	77 NTSC	50	–62	–67	< –9.3	75 Ω/Discrete Pre-D	A2362R3P	108406737
	>8	77 NTSC	52	–63	–69	< –9.3	75 Ω/Discrete Pre-D	A2365R3P	108028044
	>8	110 NTSC	51	–63	–69	< –9.3	75 Ω/Discrete Pre-D	A2366R3P	108028390
	16—18	42 CEN-ELEC	52	–63	–67	< –6.0	75 Ω/Discrete Pre-D	A2363R3P	108341116
	16—18	42 CEN-ELEC	52	–63	–67	< –6.0	75 Ω/Discrete Pre-D	A2363B3P	108230558

* 7 dB, all fiber; 9 dB includes 2 dB passive loss; 11 dB includes 2 dB passive loss; 13 dB includes 4 dB passive loss.
† Type 2: industry-standard pinout (2.5 Gbits/s type) and a 25 Ω input impedance (resistive). Type 3: Lucent pinout and a 75 Ω input impedance (transformer matched).

Note: Some codes do not conform to the standard ADN configuration scheme. An ADN that ends with D75 denotes a stand-alone module, Type-3 pinout.

For additional information, contact your Microelectronics Group Account Manager or the following:

INTERNET: **http://www.lucent.com/micro**, or for Optoelectronics information, **http://www.lucent.com/micro/opto**
E-MAIL: **docmaster@micro.lucent.com**
N. AMERICA: Microelectronics Group, Lucent Technologies Inc., 555 Union Boulevard, Room 30L-15P-BA, Allentown, PA 18103
1-800-372-2447, FAX 610-712-4106 (In CANADA: **1-800-553-2448**, FAX 610-712-4106)
ASIA PACIFIC: Microelectronics Group, Lucent Technologies Singapore Pte. Ltd., 77 Science Park Drive, #03-18 Cintech III, Singapore 118256
Tel. (65) 778 8833, FAX (65) 777 7495
CHINA: Microelectronics Group, Lucent Technologies (China) Co., Ltd., A-F2, 23/F, Zao Fong Universe Building, 1800 Zhong Shan Xi Road, Shanghai 200233 P. R. China **Tel. (86) 21 6440 0468**, **ext. 316**, FAX (86) 21 6440 0652
JAPAN: Microelectronics Group, Lucent Technologies Japan Ltd., 7-18, Higashi-Gotanda 2-chome, Shinagawa-ku, Tokyo 141, Japan
Tel. (81) 3 5421 1600, FAX (81) 3 5421 1700
EUROPE: Data Requests: MICROELECTRONICS GROUP DATALINE: **Tel. (44) 1189 324 299**, FAX (44) 1189 328 148
Technical Inquiries: OPTOELECTRONICS MARKETING: **(44) 1344 865 900** (Ascot UK)

March 1999
DS99-165LWP (Replaces DS98-198LWP)

microelectronics group

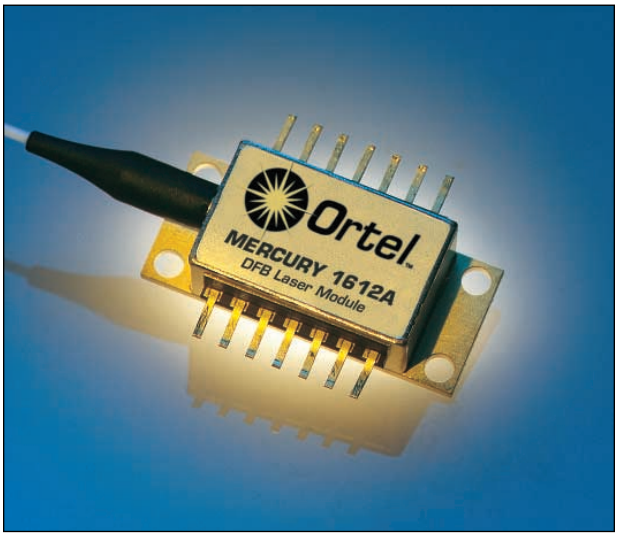
Lucent Technologies
Bell Labs Innovations

MERCURY

1310nm Forward Path DFB Laser Modules

DATA SHEET

Ortel's Mercury Lasers are 1310nm forward path DFB laser modules designed for both broadcast and narrowcast analog applications. This highly linear OC-48 pin compatible device features up to 31mW output power with a superior distortion performance over an enhanced operating temperature range of -40 to 85° C.



With 31mW of output power, the Mercury Laser enables transmission beyond 40 kilometers, and a far greater number of optical splits. In addition, the wide operating temperature range increases the laser's reliability in even the harshest environments.

RF Characteristics

	1612A	1612B
Frequency Range	40 to 860 MHz	40 to 860 MHz
Frequency Response	±0.5 dB	±0.5 dB
CNR[1]	51 dB	51 dB
CSO	57	60
CTB	67	67
RIN	<-155	<-155

[1] OMI = 3.2% MIN, 112 unmodulated NTSC channels

Optical Parameters

Wavelength	1310 ± 10 nm
Optical Output Power	16 mW - 31 mW
Optical Isolation	> 30 dB
Side Mode Suppression Ratio	> 30 dB

Model Numbers

1612A, 1612B

Ordering Information

Contact your local sales representative for current prices, or call (800) 362-3891.

applications

- **1310nm forward path**
  - ***Long distances***
  - ***Many optical splits***
- **Broadcast and narrowcast networks**

features

- **OC-48 pin compatible**
- **Negative bias**
- **112 channel loading available**
- **Meets Telcordia (Bellcore) 468 specifications**
- **High output power**

Ortel™

harnessing the power of light

DATA SHEET

MERCURY

1310nm Forward Path DFB Laser Modules

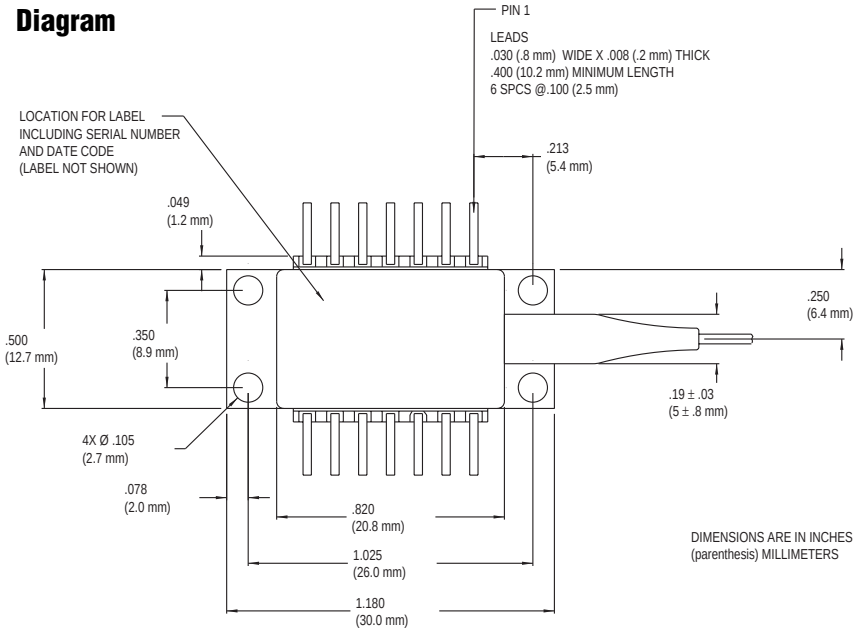
Environmental Parameters

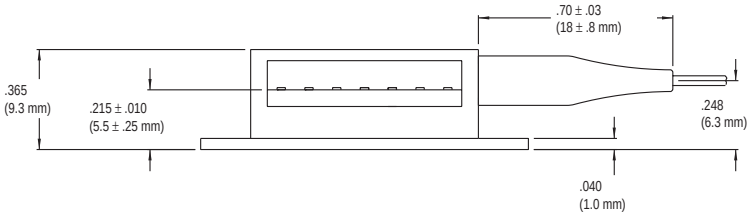
Operating Case Temperature	- 40° to +85° C
Non-Operating Temperature	- 40° to +90° C

DC Parameters

Threshold Current	≤ 30 mA
Operating Current	≤ 120 mA
Monitor Operating Current	10 - 200 µA/mW
Thermistor Resistance	10 ± .5 kΩ @ + 25° C
Thermistor Temp. Coeff.	-4.4% /° C @ +25° C (typ.)
TE Cooler Current	≤1.6A

Diagram

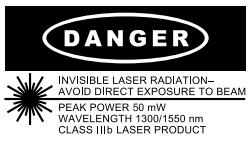




Pin Assignments

Pin	Function
1	Thermistor
2	Thermistor
3	DC Laser Bias (-)
4	MPD Anode, Case Ground
5	MPD Cathode
6	TEC (+)
7	TEC (-)
8	Case Ground
9	Case Ground
10	NC
11	Laser Common (+)
12	Laser Modulation (-)
13	Laser Common (+)
14	NC

Safety Considerations – The light emitted from this transmitter is invisible and may be harmful to the human eye. Avoid looking directly into the fiber pigtail or into the collimated beam along its axis when the device is in operation. Operating the transmitter outside of its maximum ratings may cause device failure or a safety hazard.



Corporate Headquarters
2015 West Chestnut Street
Alhambra, California USA 91803-1542
Phone: (800) 362-3891 • (626) 281-3636
Fax: (626) 458-9243
email: info@ortel.com
www.ortel.com

Eastern United States Office
(215) 489-8860
Fax: (215) 489-8865

Europe
Ortel Vertriebs GmbH
49-89-3790 7214
Fax: 49-89-3790 7249

Singapore
Ortel Asia Private Ltd.
65-254-7877
Fax: 65-254-7377

China
86-10-6526-0767
Fax: 86-10-6526-0768

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